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#16/Appeal Brief
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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

APPELLANTS: Gottlieb et al. CONFIRMATION NO. 1696

SERIAL NO.: 09/703,630 GROUP ART UNIT: 2834

FILED: November 2, 2000 EXAMINER: M. Budd

TITLE: "ELECTROMECHANICAL MOTOR"

Assistant Commissioner for Patents,

Washington, D.C. 20231

APPELLANTS' MAIN BRIEF ON APPEAL

S I R:

In accordance with the provisions of 37 C.F.R. §1.192(a), Appellants herewith submit their main brief in support of the patentability of the claims on appeal.

REAL PARTY IN INTEREST:

The real party in interest is Siemens Aktiengesellschaft, a German corporation, as Assignee of the present application.

RELATED APPEALS AND INTERFERENCES:

There are no related Appeals and no related Interferences.

STATUS OF CLAIMS:

The application was originally filed with claims 1-15. Claims 6 and 7 were cancelled in Amendment "A", filed January 9, 2002. Claims 8 and 9 were cancelled in an Amendment which accompanied the Notice of Appeal, filed on June 24, 2002, and which was entered in an Advisory Action dated July 19, 2002. Claims 1-5 and 10-15, therefore, are pending in the application. Claim 12 has been objected to, and has been stated to be allowable if rewritten in independent form, and therefore is not

a subject of the present Appeal. Claims 1-5, 10, 11 and 13-15 therefore are the subject of the present Appeal .

STATUS OF AMENDMENTS:

As noted above, an Amendment was filed on June 24, 2002, following the final rejection, which has been entered. No other Amendments have been filed following the final rejection.

SUMMARY OF THE INVENTION:

The basic structure of the embodiment which is the subject matter of the claims on appeal is shown in Figures 15A and 15B.

The motor is composed of at least one mechanical base plate 1 in which the shaft 2 of a motor is rotatably guided with a bearing as free of play as possible. First and second electromechanical drive elements are provided, each including a piezoelectric low-voltage multi-layer actuator (PMA) 3. The PMAs 3 can be respectively driven by an electrical amplifier via electrical leads 4. (p.5, l.3-8) As a result of the electrical drive of each PMA 3, in conformity with the behavior of a piezoelectrical longitudinal actuator, it expands in the axial direction approximately proportionally to the applied electrical voltage. (p.5, l.11-13)

Each PMA 3 is installed under high mechanical compressive pre-stress between a head plate 5, that has a tappet 6, a bearing block 7 and a mechanically elastic (for example, slotted) tube spring 8. The mechanical compressive pre-stress serves for avoiding damage to the PMA 3 due to tensile forces that can otherwise occur in high-frequency continuous operation, as well as for resetting the PMA 3 when it is electrically discharged. (p.5, l.14-19)

The outside surface of the drive ring 11 contacts an inner surface of a drive flange 12 of the shaft 2. The PMAs 3 lie inside the drive ring 11 and their bearings 7 are supported at the base plates 1, so as to drive the drive ring 11 that acts on the drive flange 12 that is connected to the motor shaft 2. (p. 19, l.14-17)

The durably firm connection of PMA 3, head plate 5, bearing block 7 and tube spring 8 ensues via welded connections 9. The bearing block 7 can be firmly screwed to the base plate 1 by screws conducted through oblong holes 10. (p. 6,. l. 1-3)

For producing the circular displacement motion of the drive ring 11, the PMAs 3 are driven with two sinusoidal voltage signals having the same peak amplitude that are phase-shifted by 90° relative to one another, similar to a Lissajous figure (see Figure 7A). The gap dimension between the inner surface of the drive flange 12 of the shaft 2 and the outer surface of the drive ring 11, in conjunction with the properties of the PMAs 3 and the mounting of the motor, is designed such that a high frictional lock between the shaft 2 and the drive ring 11 is present during every phase of the rolling motion, particularly when the motor is shut off (both PMAs 3 discharge). (p.6, l18- p.7, l2)

Fig. 7A shows the piezo voltage in volts of the PMAs 3 in Figs. 1 through 6 with respect to a phase angle $\varphi(t)$ in degrees. (p. 9, l. 23-24) *

Fig. 7B shows the amplitude diagram corresponding to Fig. 7B as an indication of the control voltage applied to the PMAs 3. (p. 10, l. 1-2)

* The structure of the embodiment shown in Figures 1-6, wherein the drive ring is disposed around the drive shaft, is no longer being claimed, however, the principles of operation, namely the drive of the PMAs 3. applies equally to the embodiment of Figures 15A and 15B.

The absolute phase position of the two drive signals with which the PMAs 3 of the motor are placed into operation fundamentally plays no part, as long as the relative phase displacement between the two sinusoidal drive signals amounts to 90° (otherwise, the frictional lock between shaft 2 (i.e., the drive flange 12 thereof) and drive ring 11 could be briefly lost, but even this results in no disadvantageous consequences as long as this operating condition is quickly traversed). (p. 10, l.8-13)

Proceeding from the position shown in Fig. 15A, the periodic drive of the two PMAs 3 is now begun, with the electrical signal voltages at the PMAs 3 satisfying, for example, the condition:

$$U_{PMA31}(t) = U_0 \cdot \{1+\sin(\varphi(t) + (3/2) \cdot \pi\} \quad \text{[Volts]}$$

$$U_{PMA32}(t) = U_0 \cdot \{1+\sin(\varphi(t) + \pi)\} \quad \text{[Volts]}$$

The phase positions of the appertaining drive voltages are shown in Fig. 7A). As the displacement diagram in Fig. 7B) shows, a periodic, circular displacement of the drive ring 11 results therefrom, this being converted into a rotational movement of the shaft 2 by the durable frictional lock with the drive flange 12. The positions according to Fig. 1 →Fig. 4 → Fig. 5 → Fig. 6 → Fig. 1, etc. are thereby sequentially and periodically executed by the motor. (p. 10, l. 17 - p. 11, l. 4)

For the following reasons, the displacement motion of the drive ring 11 is not exactly circular: hysteresis of the PMAs 3, articulation of the drive ring 11 to the two PMAs 3, deformation of the drive ring 11 due to mechanical forces. This distortion, however, can be compensated by a distortion-correction of the drive signals, which then are no longer exactly sinusoidal. In particular, the complete region indicated with hatching in Fig. 7B) can be electrically driven. As a result, all operating conditions relevant for the motor can be electrically driven, for example reduced

hold/torque, increased retaining moment, or free running of the motor shaft. Likewise, the rotational sense can be commutated by the phase shift of the two drive signal voltages for the PMAs 3 (shift of the drive signals by $\pm\pi$ relative to one another). P. 11, l. 5-14)

ISSUES:

The following issues are presented for review:

Whether the subject matter of claims 1-5, 8, 10 and 13 is anticipated under 35 U.S.C. §102(a) by any of United States Patent No. 5,041,753 (Clark et al.) or United States Patent No. 4,814,661 (Yamada et al.) or United States Patent No. 4,950,135 (Tojo et al.);

Whether the subject matter of claims 11 and 15 would have been obvious to a person of ordinary skill in the art under the provisions of 35 U.S.C. §103(a) based on the teachings of any of Clark et al., Yamada et al. or Tojo et al.; and

Whether the subject matter of claim 14 was described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventors, at the time the application was filed, had possession of the claimed invention, pursuant to 35 U.S.C. §112, first paragraph.

GROUPING OF CLAIMS:

The patentability of all claims on appeal stands or falls together.

ARGUMENT:

Appellants will first address the issue of whether the subject matter of claim 14 is enabled by the present specification in conformity with the requirements of 35 U.S.C. §112, first paragraph. The present application was originally filed with generic independent apparatus and method claims, covering both the embodiment

wherein the drive shaft is surrounded by a drive ring, as illustrated in Figures 1-6, and the embodiment wherein the drive ring is disposed inside of a drive flange which is, in turn, connected to the drive shaft, as shown in Figures 15A and 15B. As noted above, the claims during prosecution were limited to this latter embodiment, which is the subject matter of the claims on appeal.

A number of features were described in the present specification in the context of the first embodiment, and when the claims were limited to the second embodiment, the Examiner rejected claims directed to those features as not being supported under §112, first paragraph. Applicants did, in fact, cancel claims which were directed to *structural* details which were described in the context of the first embodiment, however, claim 14 is a method claim directed to operational features, which are equally applicable to both embodiments. Applicants acknowledge that in the present specification these operational features are described on the basis of the example of the first embodiment, however, those of ordinary skill in the art, from this explanation, can easily ascertain how those operational features apply to the second embodiment as well.

Claim 14 describes the timing and relationship of the linear displacements of the drive elements (PMAs) so as to produce the rotary motion of the drive ring which, in turn, causes the drive shaft to be rotated. The first steps of claim 14, namely disposing the drive elements at an angle relative to each other of approximately 90° in the motion plane, and the pre-stressing of the drive elements so that in an initial position of the shaft relative to the drive ring, the respective linear displacements are minimal and a permanent pressure contact is produced between the drive ring and the shaft, are clearly shown in Figures 15A and 15B. The remainder of claim 14

states that during operation the respective linear displacements are sinusoidal and chronologically act on the drive ring with a phase difference of approximately 90°. This is explained in the specification in connection with the first embodiment in Figures 7A and 7B. As also noted above, Figure 7A refers to the motion sequence described in Figures 1-6, and those figures relate to the first embodiment. Those of ordinary skill in the art, however, have no difficulty in recognizing that this same motion sequence occurs in the embodiment shown in Figures 15A and 15B, and therefore Applicants submit the subject matter of claim 14 is disclosed in the present specification in full compliance with all provisions of §112, first paragraph, even though claim 14 now depends from a claim directed only to the embodiment of Figures 15A and 15B.

As to the rejections based on the prior art references, Appellants submit the following arguments in support of patentability of the claims on appeal over the teachings of those references.

Claim 1 on appeal is directed to an electromechanical motor which has two stationarily mounted electromechanical drive elements, which respectively produce linear displacements. These drive elements are stated in claim 1 to be in mechanical connection with the interior of a drive ring, and cause this drive ring to execute a circulatory displacement rotation by a combination of the aforementioned linear displacements. Claim 1 also states that a shaft is in rolling line contact with an exterior of the drive ring, so that the shaft is rotated by the circulatory displacement motion of the drive ring. Independent claim 13 is a method claim which tracks the structural elements of independent apparatus claim 1.

Addressing the Clark et al. reference first, that reference discloses a high torque magnetic motor wherein a drive shaft 12 has an annular ring 14 rigidly connected thereto which has an interior in which a number of electrically operated lock devices 26 are disposed. The lock devices 26 extend radially toward an anchor reaction shaft 16, which is stationary relative to the shaft 12. Also disposed in the interior of the ring 14 are a number of modules 20, each containing a pair of axially aligned magnetostrictive elements 30. When the lock devices are operated so as to frictionally engage the stationary anchor shaft 16, and the magnetostrictive elements 30 are successively actuated, a torque is produced which is transmitted via the ring 14 to the shaft 12, so that the shaft 12 is caused to rotate.

Independent claims 1 and 13 each include several elements or steps which are not disclosed in the Clark et al. reference. In the Clark et al. reference, the entire assembly of the ring 14 and the modules 20 mounted in the interior thereof rotates, as indicated by the curved arrow between elements 18 and 14 near the top of Figure 1 of the Clark et al. reference. Thus, if the modules 20 or the magnetostrictive elements 30 thereof are considered to correspond to the electromechanical drive elements of claims 1 and 13, those elements in the Clark et al. reference are not stationarily mounted, as required in claims 1 and 13.

Moreover, since the ring 14 and the modules 20 in the Clark et al. reference form a single, mechanically connected assembly, and since that entire assembly rotates, thereby causing the shaft 12 to rotate as well, there is no shaft in rolling line contact with an exterior of the drive ring, as also required in claims 1 and 13. The "rolling line contact" referred to in claims 1 and 13 means that a line of contact between the exterior of the drive ring 11 and the interior of the drive flange 12 (i.e.,

proceeding perpendicularly to the plane of the drawing in Figure 15B, and represented by the boundary line between the ring 11 and the flange 12 in the side sectional view of Figure 15A, proceeds along a generally circular path as the stationarily mounted electromechanical drive elements are actuated to produce the linear displacements. No such rolling line contact is present in any of the embodiments disclosed in the Clark et al. reference, nor could any such rolling line contact be present since, as noted above, the assembly of the ring 14 and the modules 20 is in fixed relationship, and this assembly also is in fixed relationship to the shaft 12.

The Clark et al. reference therefore does not disclose all of the elements of claim 1, nor all of the method steps of claim 13, and therefore does not anticipate either of those claims under the provisions of 35 U.S.C. §103(a). Claims 2-5, 8 and 10 add further structure to the novel combination of independent claim 1, and therefore are not anticipated by Clark et al. for the same reasons discussed above in connection with claim 1.

In the Yamada et al. reference, a piezoelectric motor has shaft 14 which is fixed at the center of a rotor 1 and a lid 17 of the case 5, by means of a fixing member 20 and a bearing 19, so that rotation of the rotor 1 is transmitted to the shaft. This is described at column 2, lines 63-66 of Yamada et al. Therefore, the Yamada et al. reference does not disclose a shaft positioned outside of the stator. Moreover, there is no teaching in the Yamada et al. reference that the wall 16 of the frame is movable, and in fact the language at column 1, lines 44-47 and column 2, lines 66-68 in Yamada et al. indicates that it is not. In any event, the outermost ring in the Yamada et al. reference is apparently merely a case, and does not perform

any dynamic function, as explained at column 3, lines 27-32 and 63-66. Therefore, none of the rings disclosed in the Yamada et al. reference constitute movable parts of the arrangement. The only freely rotatable parts of the arrangement are the rotor 1 and the shaft 14 but, as noted above, the shaft 14 is disposed *inside* the rotor, which is contrary to the elements of claim 1 on appeal and the steps of method claim 13 on appeal.

Even if the triangular arrangement of the piezo elements 7, 8 and 9, as shown in Figure 1B of Yamada et al., is considered to be some form of "drive ring," this would also be positioned outside of the shaft 14, contrary to the subject matter of claims 1 and 13.

Moreover, as in the Clark et al. reference, no matter how the various elements in Yamada et al. are alleged to conform to the elements of claim 1, or the steps of claim 13, there is no occurrence (and thus no teaching) of a rolling line contact between any of those components as set forth in claims 1 and 13.

The Yamada et al. reference therefore does not disclose all of the elements of claim 1, nor all of the method steps of claim 13, as arranged and operating in those claims, and therefore does not anticipate either of those claims under the provisions of 35 U.S.C. §102(a). Claims 2-5, 8 and 10 add further structure to the novel combination of claim 1, and are therefore not anticipated by Yamada et al. for the same reasons discussed above in connection with claim 1.

Lastly, as to the Tojo et al. reference, Appellants submit the following arguments in support of patentability.

As stated above, the subject matter disclosed and claimed in the present application is an electromechanical motor, i.e., its intended purpose is to generate torque which is then available for driving some other component externally of the motor. In any motor, in order to make the torque available externally of the motor, it is necessary to provide some rotatable element which is available to transfer the torque from the motor to a driven component. In the subject matter of claims 1 and 13 of the present application, this element is the shaft which is in rolling line contact with the drive ring. The device disclosed in the Tojo et al reference, by contrast, is a scroll compressor, i.e., it is basically a pump with a very small flow rate. In all embodiments, the scroll compressor operates by rotating (called "orbiting" in the Tojo et al patent) a circular shaft inside a stationary frame 4. The basic operation of all of the embodiments, making clear that the frame 4 is stationary, is described in the paragraph bridging columns 3 and 4 of the Tojo et al patent, which specifically refers to the frame 4 as being a stationary member in column 4, lines 8-9.

In an earlier Office Action, the Examiner cited the embodiment shown in Figures 13a through 13d of Tojo et al as allegedly anticipating the subject matter a dependent claim, now included in claim 1. Claim 1 (and claim 13) state that the shaft is rotated by the circulatory displacement motion of the drive ring. In the embodiment shown in Figures 13a through 13d of Tojo et al, if the element 3 is considered to be the drive ring, and the element 4 is allegedly considered to be the shaft which is located outside of the drive ring, this structure does not correspond to the structure of claim 1 or the method of claim 13, because the element 4 in the Tojo et al reference is stationary, and in fact *must* be stationary in order for the Tojo et al device to operate as intended. If the element 4 were not stationary in all of the

embodiments disclosed in Tojo et al, it would merely wobble as the internal element orbited therein, and thus no pumping action would be produced. In order for a pumping action to be produced so as to generate fluid flow, as is desired in the Tojo et al reference, it is absolutely necessary for the frame 4 to be stationary.

Moreover, as also noted above, claims 1 and 13 state that the drive elements are stationarily mounted. This is important to the intended operation of the subject matter of claim 1 (as well as claim 13) in view of the fact that an electromechanical motor is being claimed. This is also contrary to the intended operation of the Tojo et al structure. Tojo et al, as discussed above, does not merely generically teach placing the drive ring inside of the shaft, but instead teaches, in a pump, orbiting a circular element inside a *stationary* frame.

Therefore, the Tojo et al. reference does not disclose all of the elements of claim 1, nor all of the method steps of claim 13, and therefore does not anticipate either of those claims under the provisions of 35 U.S.C. §102(a). Claims 2-5, 8 and 10 add further structure to the novel combination of claim 1, and are therefore not anticipated by Tojo et al. for the same reasons discussed above in connection with claim 1.

As to the rejection of claims 11 and 15 under 35 U.S.C. §103(a) as being unpatentable over any of Clark et al., Yamada et al. or Tojo et al., the above discussion makes clear that in each of those references the basic structure and manner of intended operation is not only different, but opposite, to the subject matter of claims 1 and 13. As to the Clark et al. and Yamada et al. references, Appellants submit that it would not even be physically possible to modify either of those references to produce a motor wherein rolling line contact between the exterior of a

drive ring, and a drive shaft, takes place, as set forth in independent claims 1 and 13. Since claim 11 embodies the subject matter of claim 1 therein and since claim 15 embodies the subject matter of claim 13, therein, neither of claims 11 or 15 would have been obvious to a person of ordinary skill in the art based on the teachings of Clark et al. or Yamada et al.

As to the Tojo et al. reference, as noted above, since the Tojo et al. reference discloses a pump, rather than a motor, it would destroy the intended operation of the pump disclosed in the Tojo et al. reference if that structure were modified so that the drive elements were stationarily mounted, as required in claims 1 and 13. Modifying a reference which destroys its intended manner of operation is not a permissible basis for substantiating a rejection under 35 U.S.C. §103(a), and therefore the subject matter of claims 11 and 15 would not have been obvious to a person of ordinary skill in the art based on the teachings of Tojo et al.

CONCLUSION:

For the above reasons, claim 14 is submitted to be in full compliance with all provisions of §112, first paragraph, and all claims on appeal are submitted to be patentable over the teachings of the references relied upon in the final rejection. Reversal of the rejection of all claims of the application is therefore justified, and the same is respectfully requested.

This Appeal Brief is accompanied by the requisite fee in the amount of $320.00 as required by 37 C.F.R. §1..192 and 37 C.F.R. §1.17(f) .

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CERTIFICATE OF MAILING

I hereby certify that an original and two copies of this correspondence are being deposited with the United States Postal Service as First Class mail in an envelope addressed to: Assistant Commissioner for Patents, Washington, D.C. 20231 on August 14, 2002.

Steven H. Noll
STEVEN H. NOLL

APPENDIX "A"

1. An electromechanical motor comprising:

two stationarily mounted electromechanical drive elements respectively producing linear displacements;

a drive ring having an interior in mechanical connection with said drive elements for causing said drive ring to execute a circulatory displacement motion by a combination of said linear displacements; and

a shaft in rolling line contact with an exterior of said drive ring, said shaft being rotated by said circulatory displacement motion of said drive ring.

2. An electromechanical motor as claimed in claim 1 wherein each of said drive elements has a piezo actuator for driving that drive element.

3. An electromechanical motor as claimed in claim 1 wherein said drive ring is circular, and wherein said drive elements are mechanically attached to said ring so that said respective linear displacements act radially on said drive ring.

4. An electromechanical motor as claimed in claim 1 wherein said circulatory displacement motion takes place in a motion plane, and wherein said drive elements are disposed relative to each other at an angle of approximately 90° in said motion plane.

5. An electromechanical motor as claimed in claim 1 wherein said circulatory displacement motion takes place in a motion plane, and further comprising at least one further electromechanical drive element, said two electromechanical drive elements and said at least one further electromechanical

drive element being disposed relative to each other at equal angles in said motion plane.

10. An electromechanical motor as claimed in claim 1 wherein said drive ring is disposed relative to said drive shaft so that a permanent pressure contact exists between said drive ring and said shaft.

11. An electromechanical motor as claimed in claim 1 further comprising at least two further electromechanical drive elements which respectively produce linear displacements, and at least one further drive ring in mechanical connection with said at least two further drive elements, said at least one further drive ring being caused to execute said circulatory displacement motion by a combination of the linear displacements of said at least two further drive elements, and said shaft being in rolling line contact with each of said drive ring and said at least one further drive ring, said shaft being rotated by the circulatory displacement motions of said drive ring and said at least one further drive ring.

13. A method for operating an electromechanical drive, comprising the steps of:

stationarily mounting two electromechanical drive elements;

placing a drive ring in mechanical connection with said two electromechanical drive elements;

producing respective linear displacements with said drive elements for causing said drive ring to execute a circulatory displacement motion by a combination of said linear displacements; and

placing a shaft in rolling line contact with an exterior of said drive ring and rotating said shaft with said circulatory displacement motion of said drive ring.

14. A method as claimed in claim 13 wherein said circulatory displacement motion takes place in a motion plane, and comprising the additional steps of disposing said drive elements at an angle relative to each other of approximately 90° in said motion plane, and pressure pre-stressing said drive elements so that in an initial position of said shaft relative to said drive ring, said respective linear displacements are minimal and a permanent pressure contact is produced between said drive ring and said shaft and so that during operation the respective linear displacements are sinusoidal and chronologically act on said drive ring with a phase difference of approximately 90°.

15. A method as claimed in claim 13 wherein drive elements are first drive elements and wherein said drive ring is a first drive ring, and comprising the additional steps of:

placing two second electromechanical drive elements in mechanical connection with a second drive ring;

producing respective linear displacements with said second drive elements and thereby causing said second drive ring to execute said circulatory displacement motion; and

placing said second drive ring in rolling line contact with said shaft for rotating said shaft by the respective circulatory displacement motions of both of said first drive ring and said second drive ring.